The Mechanical Engineer in the Early Stages of Design

During the early stages of design in an integrated project, the mechanical engineer has some responsibilities that he or she would otherwise not have in a traditional "over the wall" project. This wiki page will explain some of those responsibilities. Below are some key functions that describe what the mechanical engineer should be doing in the early stages of design.

Massing

Massing is an important energy modeling tool that can optimize the orientation of the building. It is also important for lighting designers/engineers to optimize daylighting.

What is it?

Massing is done by running a simplified building through an energy modeling tool to determine the optimal layout and orientation from an energy perspective. Each massing model should be as simple as you can make it. Try only putting in blocks of space and avoid modeling any details in the building: These details will probably change throughout the project lifetime anyway, and you will have wasted time modeling those.

Who is involved?

Massing is an iterative process mostly between the mechanical engineer, lighting designer/engineer, and the architect, but other disciplines have an equal right to be involved such as the landscape architect and the construction manager. Multiple massing model attempts should be run in order to optimize a balance between every discipline's desires.

The mechanical engineer should guide the process from an energy use perspective. Consider solar gain from different compass directions, material types on each façade, planned shading devices, and start to consider any passive ventilation options. Remember that since many of the building details were not modeled, this is not yet an accurate energy model, but you can compare the different layouts relative to one another.

The lighting engineer will focus on daylighting. The outcome of the massing plan highly determines the ability to daylight spaces, especially the spaces that are deep within the building. As a mechanical engineer, you should also highly desire good daylighting as it reduces energy use through artificial light dimming.

The architect will be thinking of his or her program layout. While the optimized program layout does not have any concrete numbers to compare the benefit of each layout, this is ultimately one of the most important parts of the design, as it is the most direct way in which the client will be interacting with their building. So, as a mechanical engineer, keep in mind that the architect might have some specific requests for the client about the layout, and those requests should be honored.

The Outcome

Shown in Fig. 1 is an example of a massing model process. Four different massing models were tried in this example, and can be compared directly to one another. The outcome of the massing model process should be a general building layout that achieves a good balance between energy use, daylighting potential, and architectural floor plan.

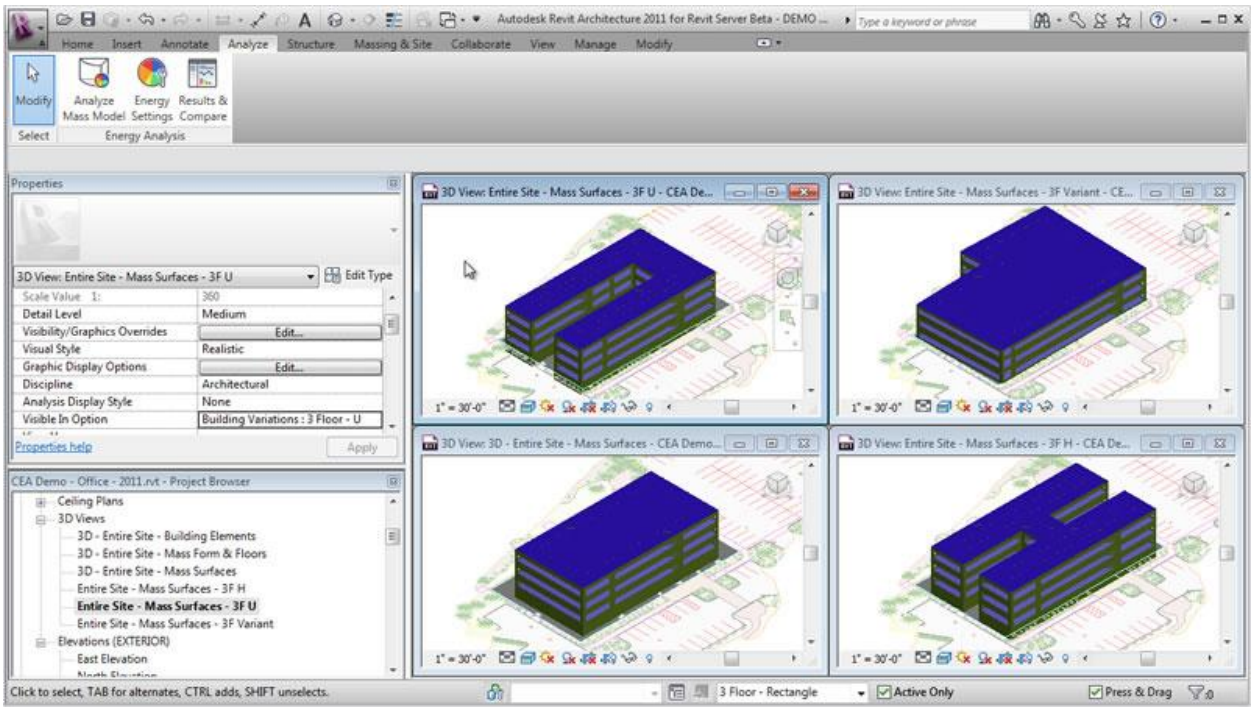

Fig. 1: An iterative massing model example.

Mechanical Room Space

As the building plan progresses, the mechanical engineer should remain active in the design process. After massing is complete, the mechanical engineer's work is only just beginning. As the architect is still in conceptual design with his or her floor plans, the mechanical engineer can make the overall design process smoother by putting in some effective input about how much space is required by planned equipment.

Easier Said than Done

As the title states, this is much easier said than done. The architect may ask you directly how much space in square feet should be allotted in the mechanical room for all the equipment needed to run the building. A problem arises, however, since you are far away from actually sizing equipment. While you may not know the exact number, a good initial guess will prevent the design team from reconfiguring the layout of the space later on.

What Can You Do Now?

You are going to have to take an initial guess at how much space you need. This should definitely NOT be a blind guess, and rather a well-researched estimate. Despite not knowing the exact equipment specifications, you can ask yourself some of the following questions:

- What is the use of the building? Different uses require different equipment. For example, a typical commercial office space will require a lot less ventilation and cooling than a fitness center space.
- Are there any key spaces in the building? Consider spaces like data system hubs that require a lot of cooling to counter the heat produced by those pieces of equipment.
- How is the building being cooled and heated? Is all chilled water to be produced on site in the building, or is it produced in an external plant? Typically, the chillers and boilers/hot water heaters place a large load on the floor space and electrical demand.

- What equipment do we need? The list of equipment you should consider includes, but is not excluded to:
    - Air Handlers
    - Boilers
    - Chillers
    - Heat Exchangers
    - Water Heaters and Tanks
    - Water Pumps (domestic, heating/cooling, and fire safety systems)
    - Elevator Machinery
- Where can you get mechanical space? For mechanical systems, both basement and roof penthouse space is valuable. Plan for both: The basement space is a great location for utility tie-in, while the roof space is a great place for the air handling units because they will have clean and supple air intake.

After considering these questions, run some initial calculations based on the floor plans available to you at this point in the project. These calculations do not necessarily need to be too in depth, but get a rough estimate of the total airflow rate, amount of heating and cooling needed, and any other specialty equipment needed in the building. Go to some manufacturer's catalogs and pick out a standard model that fits something around the size you need. Again, this definitely does not need to be exact. Some manufacturer's catalogs that I found useful for this stage of design:

- TRANE http://www.trane.com/COMMERCIAL/Products/Default.aspx?i=876
- Carrier http://www.commercial.carrier.com/commercial/hvac/homepage/1,3052,CLI1_DIV12_ETI372,00.html

Once you find the total floor area of each of your planned equipment, remember to add some space for setback and access. After that, I would highly recommend adding 50% more space to the final number you get, to allow for any equipment that you forgot about, as well as some growth in case you decide to use some larger equipment.